



**Bison and elk are the remaining reservoirs of brucellosis in the United States. RB51, the new vaccine that protects bison from the disease, will be evaluated for protection of elk (shown above).**

KEITH WELLER (K8751-1)



**Microbiologist Diana Whipple (left) and animal caretaker Katy Lies offer treats to a white-tailed deer being used to study tuberculosis in its wild counterparts.**





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**Z**oonoses—animal diseases that are naturally communicable to humans—have inflicted health problems on millions of people worldwide. But the power of three devastating zoonotic diseases—brucellosis, leptospirosis, and tuberculosis (TB)—may someday be broken up by new knowledge of how they are transmitted from wildlife to domestic animals to humans. Agricultural Research Service researchers at the National Animal Disease Center (NADC) in Ames, Iowa, are gaining this knowledge.

White-tailed deer in northeast Michigan have recently been identified as a wildlife reservoir of TB, which is caused by *Mycobacterium bovis*. The bison is a natural host for brucellosis. Leptospirosis, also called Weil's Disease, is transmitted to humans mainly through direct contact with infected animals, but it can also sicken humans via contaminated soil or water.

"Elk, deer, and bison threaten U.S. brucellosis and tuberculosis eradication efforts by presenting the opportunity for reinfection," according to ARS veterinarian Carole A. Bolin, leader of bacterial disease research.

As USDA's chief scientific research agency, ARS assists and advises other USDA agencies working with zoonotic diseases—the Animal and Plant Health Inspection Service (APHIS) and the Food Safety and Inspection Service (FSIS)—and other federal agencies like the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia.

### TB Transmission

Milk is pasteurized to safeguard humans from becoming infected with *M. bovis*. The incidence of TB in cattle has declined steadily since 1917 when the state-federal eradication program was begun. In 1992, however, there was a resurgence of the disease. In addition, tuberculosis in captive deer and elk was recognized as a growing problem.

The presence of TB in wild white-tailed deer in Michigan poses a serious threat to the program to eradicate the disease from domestic livestock. ARS scientists have been conducting research on TB in white-tailed deer to determine how to control and one day eliminate it.

ARS microbiologist Diana Whipple and ARS veterinarian Mitchell V. Palmer developed a method to experimentally infect white-tailed deer with *M. bovis*. This method has been used to study the transmission of TB from experimentally infected deer to noninfected deer in research pens at NADC.

Their work has provided the first animal model to study TB transmission in white-tailed deer. "White-tailed deer experimentally infected with *M. bovis* developed lesions similar to those found in naturally infected deer," says Whipple.

In other studies, Whipple says NADC researchers have identified a possible route of transmission of *M. bovis* from experimentally infected deer to other animals. "We found *M. bovis* in deer saliva and nasal and tonsil secretions. Therefore a cow or another deer might become infected with *M. bovis* by eating feed contaminated with these secretions," says Whipple.

DNA fingerprints show that both wild and captive deer in Michigan are infected with the identical strain of *M. bovis* recovered from coyotes, raccoons, a bear, and cattle.

### Tracking Leptospirosis

From Michigan deer to a public body of water in Springfield, Illinois, and in remote areas of Nicaragua, ARS researchers have tracked another bacterial disease that plagues animals and humans. Leptospirosis is caused by spiral-shaped bacteria called spirochetes (SPY-row-keets). Infected domestic animals and wildlife harbor these bacteria, more than 200 of which can cause leptospirosis.

To complicate matters, some animal species can be a host to several different bacterial strains, although usually animals are infected with only one type at a time. Humans can contract the disease, which is treatable with antibiotics, from urine if traces come in contact with the membranes around their eyes and mouth.

An international expert on zoonotic diseases, Carole Bolin traced the cause of a human outbreak of leptospirosis in Nicaragua to dogs. (See "Cracking the Hard Cases," *Agricultural Research*, June 1996, p. 4.)

In June 1998, Bolin was called by the CDC to help investigate the cause of a feverish illness in more than 100 U.S. athletes who became ill after swimming

in Lake Springfield. The illness resembled leptospirosis. NADC researchers tested water samples from the lake and isolates of bacteria from the patients. They also surveyed the livestock and wildlife residing near Lake Springfield. Laboratory tests confirmed the presence of pathogenic leptospires in the lake; however, the scientists were not able to identify the specific animal source.

### New Vaccines

In cattle, leptospirosis causes abortions, stillbirths, and reproductive inefficiency. The NADC researchers have studied this disease since 1987. Their studies show that previous commercial vaccines for cattle have not adequately protected them against some types of leptospirosis.

However, “a new vaccine, developed by BioCore in Omaha, Nebraska, gives 100 percent protection to cattle. Use of the vaccine blocks bacterial colonization in the urinary and reproductive tracts of the cattle,” says Bolin. She and her research team are gathering data to

support licensing of the commercial vaccine.

This is not the first time NADC researchers have supported and tested new vaccines to protect cattle against zoonotic diseases. ARS veterinarian Steven C. Olsen continues to explore the use of *Brucella abortus* strain RB51 in adult bison.

“Brucellosis in bison is very similar to brucellosis in cattle,” says Olsen. He and the research team of Mark G. Stevens, Mitchell V. Palmer, Shirley M. Halling, Betsy J. Bricker, and Norman F. Cheville extensively tested RB51 for cattle. Because of their efforts, RB51 was approved by the USDA as the official vaccine to protect U.S. cattle against brucellosis, which costs U.S. beef and dairy producers nearly \$30 million annually. This was the first time in over 50 years that a new vaccine was approved for brucellosis in cattle. RB51 replaced strain 19, a vaccine that is essentially no longer used.

Preliminary data suggest that the RB51 vaccine also protects bison against

brucellosis. A larger study of bison heifer calves—now under way—should provide more conclusive data on the efficacy of the RB51 vaccine for calves. The animals were vaccinated as calves and have been growing up. Once they get pregnant, the bison will be challenged with a virulent strain of *B. abortus* to evaluate whether the RB51 vaccine protects them against abortion or infection. This study, begun in 1996, will not be concluded until the spring of 2000.

To lay the groundwork for commercial use of RB51 in bison, Olsen collaborated with scientists from the Wyoming Game and Fish Department and APHIS to evaluate the potential effect of the vaccine on several nontarget species. “RB51 did not cause visible signs of disease in birds, rodents, or other wild species. What we know about using RB51 in bison calves is that the young animals don’t shed the vaccine strain; it persists longer in their lymph nodes than it does in adult cattle.

“By next spring, we may have enough data to obtain a conditional approval for using RB51 in bison calves,” says Olsen. Since 1996, commercial use of RB51 has been only in calves—both bison and cattle. The results of inoculating bison calves with RB51 should pave the way for considering its use in a program to control bison brucellosis in Yellowstone National Park. This decision will be made by the National Park Service.—  
**By Linda McGraw, ARS.**

*This research is part of Animal Health, an ARS National Program (#103) described on the World Wide Web at <http://www.nps.ars.usda.gov/programs/appvs.htm>.*

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**Veterinarian Carole Bolin prepares to inject a cow with the new vaccine for bovine leptospirosis.**